CTN Test Report

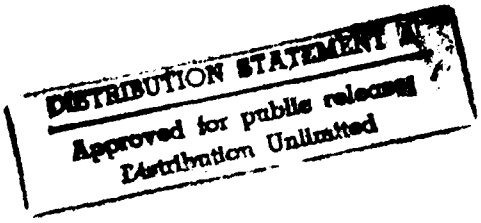
CALS TEST NETWORK 90-045 AFTB-ID-90-013

Technical Publication Transfer Test Using GTE Government Systems Provided Data: MIL-M-28001 (SGML) and MIL-R-28003 (CGM)

Quick Short Test Report

October 25, 1990

Prepared for
Air Force Logistics Command
Air Force CALS Test Bed (LMSC/SNX)
Wright-Patterson AFB, OH 45433-5000



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CTN Test Report
90-045

AFTB-ID-90-13

Technical Publication Transfer

Using GTE Government Systems

Provided Data:

MIL-M-28001 (SGML)

MIL-R-28003 (CGM)

Quick Short Test Report

25 October 1990

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1. Introduction

1.1 Background

The DoD Computer-aided Acquisition and Logistic Support (CALS) Test Network (CTN) is conducting tests of the military standard for the Automated Interchange of Technical Information, MIL-STD-1840A, and its companion suite of military specifications. The CTN is a DoD-sponsored confederation of voluntary participants from industry and government managed by the Air Force Logistics Command.

The primary objective of the CTN is to evaluate the effectiveness of the CALS standards (Standards) for technical data interchange and to demonstrate the technical capabilities and operational suitability of those Standards. Two general categories of tests are performed to evaluate the Standards, formal and informal. Formal tests are large, comprehensive tests that follow a written test plan, require specific authorization from DoD, and may take months to prepare, execute, and report.

Informal tests are quick and short, taking only a few hours to set up and execute. They are used by the CTN technical staff to broaden the testing base by including representative samples of the many systems and applications used by CTN participants. They also allow the CTN staff to gain feedback from many industry and government interpretations of the Standards, to increase the base of participation in the CALS initiative, and to respond, in a timely manner, to the many requests for help that come from participants. Participants take part voluntarily and are benefited by receiving an evaluation of their latest implementation (interpretation) of the Standards, interacting with the CTN technical staff, gaining experience in use of the Standards, and developing increased confidence in them. The results of informal tests are reported in Quick Short Test Reports (QSTRs) that briefly summarize the standard(s) tested, the hardware and software used, the nature of the test, and the results.

1.2 Purpose

The purpose of the informal test reported in this QSTR was to analyze GTE Government Systems' interpretation and use of the CALS standards in transferring technical publications data including CGM files. GTE used its CALS Technical Data Interchange System to produce data in accordance with the Standards and delivered it to the CTN technical staff on a 9-track magnetic tape.

2. Test Parameters

Test Plan: AFTB 90-13

Date of Evaluation: October 25, 1990

Evaluators:
Air Force CALS Test Bed
HQ AFLC LMSC/SNX
Wright-Patterson AFB, OH 45433-5000

Data Originator:
GTE Government Systems Corporation
80 "A" Street
Needham, MA 02194

Data Description:
Operation and Technical Manual
Red Telephone Switching Subsystem
1 text file
91 CGM files

Data Source System:

Text/SGML
DEC MicroVAX II system
Author Editor
IBM PC
FastTag

CGM
Macintosh II
MacDraw II
IBM PC
Graph Porter

Evaluation Tools Used:

1840A SUN 3/280
CTN TAPETOOL (v1.0) UNIX
SUN 3/60
Agfa Compugraphics CALS

	SGML	Cheetah Gold 486 Exoterica XGML SUN 3/60 Agfa Compugraphics CALS
	CGM	Metacals
Standards Tested:		MIL-STD-1840A Notice 1 MIL-M-28001 MIL-D-28003

3. 1840A Analysis

3.1 External Packaging

The tape arrived at the Air Force Test Bed enclosed in a box IAW ASTM D 3951. The exterior of the box was marked with the required magnetic tape warning label, MIL-STD-1840A, para. 5.3.1.3.

The tape was not enclosed in a barrier bag or barrier sheet material as required by MIL-STD-1840A, para. 5.3.1.2. Enclosed in the box was a packing list showing all files that were recorded on the tape.

3.2 Transmission Envelope

The nine-track tape received by the Air Force Test Bed contained MIL-STD-1840A files. The files were named per the standard conventions.

3.2.1 Tape Formats

The 1840A Tape was run through the AFTB TAPETOOL utility version 1.1. No errors were encountered while evaluating the contents of the tape labels.

The tape was also run into the AFTB system using Agfa Compugraphics read1840A utility. No errors were noted.

3.2.2 Declaration and Header Fields

No errors were reported with these files.

4. SGML Analysis

The GTE Government systems text submission consisted of 165 pages of tagged text with seven tagged tables. GTE provided a listing of the type tag and number of occurrances in the document. This list is in included in Appendix E.

The text file from this document was tested using the Software Exoterica XGML parser. With the text file parsed using the 38794B DTD, over 500 errors were reported. Many of these errors relate to the external entity references made at the start of the document.

Parsing the file without the 38784B DTD, over 300 errors were reported. The majority of these errors relate to incorrect ROW references in tables. A shortened part of the error log is shown in Appendix B.

The file was also parsed using the SOBEMAP product in Agfa Compugraphics CAPS/CALS. The initial parsing attempt was not successful. The problem was in the added information on the DOCTYPE line of the SGML document. Once this information was removed the document parsed with errors. They relate to TABLE callouts and were the same errors as reported by XGML.

The document was then made into an Agfa CAPS document and displayed on the screen. Currently, the Agfa product does not support CGM files so these were not inserted into the screen display.

5. CGM Analysis

This tape contained 91 CGM files. Agfa Compugraphics has just announced a CGM addition to their CALS software. This should be available in the near future in the AFTB for CGM analysis.

These files were checked using METACALS, a CGM conformance testing software by Bruce Garner of LLNL. All files were shown to be valid CGM files, but they did not meet MIL-D-28003 requirements. All files had one error listed. Twenty of the files had one or more other warning associated with the file. Appendix D is the results of the this analysis.

6. Conclusions and Recommendations

In summary, the MIL-STD-1840A tape from GTE Government Systems was correct. The tape could be read properly using the CTN TAPE-TOOL Software without errors

The SGML file was read correctly and processed using the Agfa CALS/CAPS software. Many errors resulted during the parsing operation which could be traced to TABLE calls in the document when using both the SOBEMAP and XGML parser.

See conclusions in Appendix of CGM files.

The tape provided both the Air Force Test Bed and GTE Government Systems personnel a valuable learning tool.

7. Appendix A - Tape Tool Report Logs

7.1 Tape Catalog

CALS Test Network Tape Evaluation - Version 1.1

MIL-STD-1840A Tape Evaluation Catalog

Mon Oct 22 17:01:19 1990 Document File Set Directory:
/cals/tapetool2/Set018

Page: 1

File Name	File Type	Record Type	Record Length
d001	Document Declaration	D	00260
d001t001	Text	D	00260
d001c001	CGM	F	00080
d001c002	CGM	F	00080
d001c003	CGM	F	00080

<<<<<<<<< Remainder of file deleted >>>>>>>>>

7.2 Tape Import Log

```
CALS Test Network Document File Set Validation - Version 1.1

MIL-STD-1840A Imported Document File Set Validation Log

Found file: d001
Renaming Document Declaration file: d001
Extracting 1840A Document Declaration header records...
Validating Document Declaration header records...

srcsys: GTE_GOVERNMENT_SYSTEMS_CALS_VAX_B
srcdocid: RTSS_OPER_AND_MAINTENANCE_MANUAL_VOL1
srcrelid: NONE
chglvl: ORIGINAL
dteisu: 19900919
dstsys: CALS_TEST_NETWORK_HQ_AFLC_LMSC/SJT_WRIGHT-PATTERSON AFB
dstdocid: RTSS_OPER_AND_MAINTENANCE_MANUAL_VOL1
dstrelid: NONE
dtetrn: 19900918
dlvacc: NONE
filcnt: T1,C91
ttlcls: UNCLASSIFIED
doccls: UNCLASSIFIED
doctyp: Technical Publication
docttl: NONE

Saving Document Declaration header file: d001_hdr

Found file: d001t001
Renaming Text file: d001t001
Extracting 1840A Text header records...
Validating Text header records...

srcdocid: RTSS_OPER_AND_MAINTENANCE_MANUAL_VOL1
dstdocid: RTSS_OPER_AND_MAINTENANCE_MANUAL_VOL1
txtfilid: W
doccls: UNCLASSIFIED
notes: NONE

Saving Text header file: d001t001_hdr
Saving Text data file: d001t001_txt

Found file: d001c001
Renaming CGM file: d001c001
Extracting 1840A CGM header records...
Validating CGM header records...
```

srcdocid: RTSS_OPER_AND_MAINTENANCE_MANUAL_VOL1
dstdocid: RTSS_OPER_AND_MAINTENANCE_MANUAL_VOL1
txtfilid: W
figid: F1
srcgph: C1
doccls: UNCLASSIFIED
notes: NONE

Saving CGM header file: d001c001_hdr
Saving CGM data file: d001c001_cgm

<<<<< PART OF LOG REMOVED HERE >>>>>>>

Checking file count...
No errors were found.
File Count verification complete.

No errors were encountered in document d001.

No errors were encountered during validation.

MIL-STD-1840A File Set Validation Complete.

7.3 Tape Error Log

No errors reported.

8. Appendix B - Parser Logs

8.1 Exoterica Parser Error Log

```
C:\XGML\XGMLNORM.EXE --
Error on line 549 in file \9013\d001t001:
Undeclared attribute specification.
For start tag 'TABLE': Unknown attribute is 'SCILEVEL'.
Allowed attributes for the element 'TABLE' are: 'ID', 'INSCHLVL',
'DELCHLVL', 'LABEL', 'TEXTTYPE', 'ITEMID', 'CONFIG', 'SKILLTRK', 'HCP'
and 'XREF'.

C:\XGML\XGMLNORM.EXE --
Error on line 560 in file \9013\d001t001:
Attribute does not have a current value.
For start tag 'ENTRY': For CURRENT NMTOKEN attribute 'ROW'..

C:\XGML\XGMLNORM.EXE --
Error on line 562 in file \9013\d001t001:
Attribute does not have a current value.
For start tag 'ENTRY': For CURRENT NMTOKEN attribute 'ROW'..

C:\XGML\XGMLNORM.EXE --
Error on line 569 in file \9013\d001t001:
Attribute does not have a current value.
For start tag 'ENTRY': For CURRENT NMTOKEN attribute 'ROW'..

C:\XGML\XGMLNORM.EXE --
Error on line 571 in file \9013\d001t001:
Attribute does not have a current value.
For start tag 'ENTRY': For CURRENT NMTOKEN attribute 'ROW'..
```

<<<<<<<<<< Remainder OF LOG REMOVED HERE >>>>>>>>>>
<<<<<<<<<< MORE ROW ERRORS >>>>>>>>>>

8.2 Agfa Compugraphics Parser Log

```
<!--*** file:nold.T.sgm line:560 pos:23292
Missing first specification of a CURRENT default value type attribute
(ROW)-->

<!--*** file:nold.T.sgm line:562 pos:23332
Missing first specification of a CURRENT default value type attribute
(ROW)-->
```

```
<!--*** file:nold.T.sgm line:569 pos:23400
Missing first specification of a CURRENT default value type attribute
(ROW)-->

<!--*** file:nold.T.sgm line:571 pos:23435
Missing first specification of a CURRENT default value type attribute
(ROW)-->


559      <THEAD>
560      <ROW>
561      <ENTRY COL="1">MAJOR COMPONENT
562      </ENTRY>
563      <ENTRY COL="2">DESCRIPTION
564      </ENTRY>
565      </ROW>
566      </THEAD>
567
568      <TBODY>
569      <ROW>
570      <ENTRY COL="1">RED Switch
571      </ENTRY>
572      <ENTRY COL="2">
573      </ENTRY>
574      </ROW>
```

<<<<<<<<< PART OF LOG REMOVED HERE >>>>>>>>>
<<<<<< MORE TABLE-ROW ERRORS >>>>>>>>>>

9. Appendix C - SGML Tags Used

NAME	COUNT	DESCRIPTION
BODY	1	Body Matter
CHAPTER	1	Chapter
COLBDDEF	7	Column Body Definition
COLHDDEF	19	Column Heading Definition
CONTENTS	1	Generated Table of Contents
CONTRNO	1	Contract Number
DEF	161	Definition
DEFLIST	19	Definition List
DOC	1	Document Level Element
DOCNO	1	Document Number
DOCTYPE	1	Document Type
ENDEMPH	258	End Emphasis
ENTRY	382	Table Entry
FIGURE	91	Figure
FRONT	1	Front Matter
GLOSSARY	1	Glossary
GLOSSHD	19	Glossary Head
GRAPHIC	91	Graphic
IDINFO	1	Title Page
ILUSLIST	1	Generated Illustration List
LEP	1	Gen. List of Effective Pages
MFR	1	Manufacturer
MODELNO	1	Equipment Model Number
NOMEN	1	Equipment Nomenclature
NOTICE	2	Notice
PARA	11	Paragraph
PARA0	22	Primary Paragraph
PARATEXT	720	Paragraph Text
PRECAUT	5	Precaution
PRTITLE	1	Prime Title
PUBDATE	1	Publication Date
PUBNO	1	Publication Number
REAR	1	Rear Matter
ROW	131	Table Row
SAFESUM	1	Safety Summary
SECTION	3	Section
STEMPH	258	Start Emphasis
STEP1	262	Procedural Step, First Level
STEP2	19	Procedural Step. Second Level
SUBPARA1	79	Subordinate Paragraph, 1
SUBPARA2	78	Subordinate Paragraph, 2
SUBPARA3	67	Subordinate PAragraph, 3
TABDEF	9	Table Definition
TABLE	9	Table

TABLIST	1	Generated List of Tables
TBODY	9	Table Body
TERM	161	Symbol
THEAD	8	Table Head
TITLE	350	Title
TITLEBLK	1	Title Block Matter
USER	1	User Service
WARNING	6	Warning
WARNSUM	1	Warning Summary
XREF	138	Cross Reference

10. Appendix D - CGM Analysis

Analysis and Testing of Transfer of Images Using Computer Graphics Metafiles (CGMs) from GTE Govenment Systems

The 91 metafiles were stripped of their MIL-STD-1840A headers at CTNO-East. They were provided to CTNO-West on DOS floppy disk.

Each of the 91 GTE metafiles was analyzed with two beta version programs for analysis of CGMs. These CGM analysis programs, ValidCGM and MetaCALS, check CGMs for agreement with the requirements of MIL-D-28003 and, in the case of MetaCALS, with the requirements of ISO 8632 also. The errors found are discussed in this report.

All of the metafiles were interpreted and plotted with MetaView on an IBM compatible (DOS) personal computer. In addition, some of the files also were plotted with CGMView and/or GPLOT on a SUN/3 computer running under the UNIX operating system. Several CGMs were converted from binary CGM format to clear text format in order to modify the CGMs so that several details of image interpretation could be illustrated.

10.1 Analysis

10.1.1 File Size

The GTE CGMs, stripped of their 1840A headers, ranged from 960 bytes to 146880 bytes. File sizes are listed in Table 2.

10.1.2 Elements used in GTE CGMs

The general nature of the GTE illustrations, nearly all of which are schematic diagrams of communications systems, leads to a general similarity in the metafiles and to a relative simplicity in their make-up of CGM elements. All of the files use the same set of Delimiter, Metafile Descriptor, Picture Descriptor, Attribute, Escape and External Elements. The element parameters have not been examined. Only one file, d004.cgm, invokes a Control Element. Only three to six Graphical Primitive Elements are used in any one metafile. To the extent examined, the POLYLINE element is used only for two-point lines. This differs from previously examined metafiles in which large numbers of POLYLINEs with hundreds of points are the primary tool for construction of complex images.

The number of different elements used and the number of occurances of each are summarized in Table 1.

10.1.3 Summary of Graphical Primitive Elements used

The GTE CGMs use from 27 to 677 Graphical Primitive Elements per file. This relatively small element count is a result of the type of image represented, generally schematic diagrams made up of regular closed shapes with connecting lines and arrows and with labels.

Only eight Graphical Primitive Elements are used. They are POLYLINE, RESTRICTED TEXT, POLYGON, CELL ARRAY, RECTANGLE, ELLIPSE, ELLIPTICAL ARC, and ELLIPTICAL ARC CLOSE. The use of CELL ARRAY materially increased the size of the files in which it was used.

The number of occurances of each Graphical Primitive Element in each GTE metafile is given in Table 2.

10.1.4 Errors in CGM Files

Each of the 91 GTE metafiles was analyzed with a prerelease version of MetaCALS and with the "beta" version of ValidCGM. The MetaCALS analysis software checks CGMs for agreement with the requirements of both ISO 8632 and MIL-D-28003. ValidCGM looks at agreement with the equirements of MIL-D-28003. The errors discovered by MetaCALS are listed in Table 3 and are discussed here.

Zero Area CLIP RECTANGLE (ISO 8632/ANSI X3.122 error)

One file, d004.cgm, defined a CLIP RECTANGLE with zero area. The CLIP RECTANGLE defines the portion of the picture that will be displayed if the CLIP INDICATOR is "on." As CLIP INDICATOR is never called, this is a technical error only and does not affect performance. The element, CLIP RECTANGLE, is called fifteen times in this metafile. As CLIP INDICATOR never is called, it is not clear why the CLIP RECTANGLE element is called at all.

This error had no effect on image transfer.

END METAFILE Element Missing (ISO 8632/ANSI X3.122 error)

The END METAFILE element is missing in seven metafiles, d016, d029, d056, d058, d068, d077 and d089. It must be presumed that this error would not occur in a production transfer, in which both sending and receiving systems have been well tested. In the present instance it is not known where the END METAFILE element was lost. However, as the END PICTURE element is present, it is unlikely that other data also may have been trimmed away.

This error had no observable effect on image transfer. Comparison with the original files would be necessary to determine whether or not any data was lost.

Reference to Undefined Foreground Color (ISO 8632/ANSI X3.122 error)

In eleven metafiles an undefined foreground color is referenced by a primitive. This suggests that the system which originated the metafiles may require modification of the CGM generator to ensure that appropriate definition is made of both foreground and background color.

This error had no observable effect on image transfer.

Illegal Characters in RESTRICTED TEXT Element (ISO 8632/ANSI X3.122 error)

The RESTRICTED TEXT element is reported by MetaCALS to contain invalid, illegal characters in four metafiles. In fact, the present versions of ISO 8632 and MIL-D-28003 do not specifically restrict all non-printing characters while MetaCALS reports the occurrence of such as an error. The forthcoming draft of MIL-D-28003A is reported to prohibit all non-printing characters in TEXT and RESTRICTED TEXT strings.

This error had no observable effect on image transfer.

CHARACTER SET LIST Element Error (MIL-D-28003 error)

Only one MIL-D-28003 error occurred, but that occurred in all 91 metafiles. According to MIL-D-28003, the CHARACTER SET LIST element must contain exactly the two list entries: (0,"4/2") and (1,"4/1"). The GTE files icluded the list entry, (STD94 "4/2" STD96 "4/1"). At present this may be considered a technical, rather than practical, error. The generating system software should be modified to meet this requirement of MIL-D-28003.

This error was not found by ValidCGM. It had no observable effect on image transfer with the interpreters used.

10.2 Comments on Plots of CGM Files

Comparison of plots of the received metafiles with plots produced by the originating system showed several visual discrepancies, as follows:

> Apparent mismatch of end positions of butt-joined lines. Shift to the left of text strings unless interpreter option selected. "Blocking" of some parts of image represented by CELL ARRAY.

The "mismatch" and the "blocking" errors were sufficiently serious to require minor editing of the received images prior to publication.

10.2.1 Apparent Mismatch of End Positions of Butt-Joined Lines

Apparent mismatch in the joining of lines is noted is the MetaView plots of several of the metafiles as supplied. The effect is most obvious in a plot of the file, d005.cgm, as shown in Figures 1 and 2. These figures permit comparison of the image from the originating system with that from MetaView. The mismatch in the joining of the ends of several heavy lines at the left side of this image might be due either to a data error or to an interpreter error.

A clear text file was created using the format conversion capability of GPLOT. Examination of the listed elements shows that the LINEWIDTH element had only two values, 1 and 4, so that the heavier lines are LINEWIDTH = 4. The clear text file was edited to comment out all graphical primitives except those with LINEWIDTH = 4. A plot of this clear text metafile with MetaView gave lines identical to those in the plot of the original binary CGM.

The pertinent POLYLINE elements from the clear text file as given here show that the coordinates of the end points of the lines do not agree.

```
VDCExt(0,0)(504,396);          < coordinate system
LineWidth 4;
Line(196,329)(196,231);        < x and y values of start
LineWidth 4;                     and end of line
Line(173,221)(217,221);              "
Line(173,232)(198,232);              "
Line(175,233)(175,219);              "
Line(55,329)(179,329);               "
Line(215,222)(215,206);              "
```

The "mismatched" line joins are inherent in the transmitted data and the cause for the data errors is not known.

10.2.2 Shift to LEft of RESTRICTED TEXT Strings

It is well known in the graphics standards community that placement of a text string within the bounding rectangle of the RESTRICTED TEXT element is not well defined. This uncertainty affects both the CGM generator and the CGM interpreter. There is uncertainty both in the creation of the bounding rectangle by the generator and in the placement of text in the bounding rectangle by the interpreter. In this instance the generating software, GraphPorter, is known to define a "box" that just fits the displayed text. However, the current version of the CGM standard does not require a matching fit of the text string into the defined "box". This "fizzyness" in the standard is not a problem when the interpreter is written to conform to common practice. One interpreter used in this study, MetaView, permits operator selection of either of two modes of placement of text in the bounding rectangle of the RESTRICTED TEXT element. One of these modes gives the a satisfactory interpretation of the text strings as indended by the originating system.

All text in the GTE metafiles is represented by the RESTRICTED TEXT element. Figure 3 shows the originating system's plot of the image of file, d004.cgm, and Figures 4 and 5 show the MetaView plots with the two available modes for RESTRICTED TEXT.

Amendment 3 to ISO 8632 (CGM) provides means for exactly defining the placement of text within the bounding rectangle of the RESTRICTED TEXT element. A draft of MIL-D-28003A, not yet released at the time of writing, also will incorporate this more exact definition.

10.2.3 "Blocking" of image by CELL ARRAY

There are several instances in interpreting the 91 metafiles from GTE where portions of the image which appear in the original plots do not appear in the plots obtained from the receiving CGM interpreters. This occurs several times in the previously referenced file, d004.cgm, as shown in Figure 3. Again, the clear text conversion of the files permits not only examination of the files for reasons for this behavior, but also modification of the files to illustrate the problem.

In each case the files include the CELL ARRAY element, used generally to insert a small "picture" into the otherwise sche-

matic image. The user apparently expects the black on white "pictures" to be transparent in the white regions, so that the CELL ARRAYs may be overlapped without blocking the previously plotted image. The CGM standard includes a TRANSPARENCY element that applies to several graphical primitive elements, but does not apply to the CELL ARRAY element. Consequently the CGM interpreter that lets a CELL ARRAY element block the previously laid down image is correct. It is interesting that one interpreter, GPLOT, permits "transparent" CELL ARRAYs even though they are violations of the CGM standard. This construction of GPLOT was adopted because many users of GPLOT were working with "illegal" CGMs that assumed transparency in interpretation of CELL ARRAYs.

Figure 6 illustrates the blocking of the previously laid down image by subsequently plotted CELL ARRAYs.

A recommendation for application of transparency to CELL ARRAY background color is to be prepared. This change would apply both to the ANSI/ISO standard and to MIL-D-28003A. In the meantime, members of the ISO committee responsible for CGM have been asked to consider a "fix" to this problem.

10.3 *Conclusions* and Recommendations

The transfer of GTE illustrations in the form of Computer Graphics Metafiles was generally successful with the interpreters available at the receiving system.

The GTE metafiles made good use of the more complex graphical primitive elements such as rectangle and ellipse. Polylines were used only for simple lines between two points.

Analysis of the CGMs with the MetaCALS and ValidCGM programs for evaluation against the requirements of ISO 8632 and MIL-D-28003 revealed one deviation in a required character string for the CGM element, CHARACTER SET LIST. Other errors in one or more files included: a zero area CLIP RECTANGLE, nor referenced; missing END METAFILE element; reference to undefined foreground color; and illegal (non-printing) characters in a RESTRICTED TEXT element. None of the technical errors had any practical effect in interpretation of the metafiles. The generating system software should be modified to fix theses errors.

An apparent data error was noted in the coordinates for lines meeting in either end-to-end joints or in "T" joints. This error was not related to CGM.

The use of the RESTRICTED TEXT element for all text provided an example of the problems that may occur due to the present imprecise definition of this CGM element in the ISO standard for Computer Graphics Metafile. At present, it is necessary the determine whether generating and receiving systems provide compatible treatment of the RESTRICTED TEXT element.

Blocking of some parts of several images was caused by the improper use of the CELL ARRAY element. CGM does not permit that background color in a CELL ARRAY be transparent, so that a CELL ARRAY interpreted after other elements may block out the previously laid down image. It is recommended that the CGM standards, ISO 8632 and MIL-D-28003, be modified to permit transparency for CELL ARRAYs as practiced in many drawing programs.

10.4 Table 1 - Distribution of CGM Elements

The files included the following distribution of elements:

Element Class		Number of different elements	Number of occurances
Delimiter Elements	(Class 0)	5	5
Metafile Descriptor Elements	(Class 1)	14	14
Picture Descriptor Elements	(Class 2)	7	7
Control Elements	(Class 3)	0-1	0-15
Graphical Primitive Elements	(Class 4)	3-6	27-677
Attribute Elements	(Class 5)	14	11-406
Escape Elements	(Class 6)	0	0
External Elements	(Class 7)	0	0

Only one file, d004.cgm, had a Control Element. File size, the distribution of Graphical Primitive Elements and total number of elements for each file are given in Table 1.

10.5 Table 2 - Occurance of Graphical Primitive Elements

Number of each element for each file

Element ---> & Element Number / File Number	File Size, Bytes	POLYLINE (4-1)	RESTRICTED TEXT (4-5)	POLYGON (4-7)	CELL ARRAY (4-9)	RECTANGLE (4-11)	ELLIPSE (4-17)	ELLIPTICAL ARC (4-18)	ELLIPTICAL ARC CLOSE (4-19)	Total Elements in Metafile
d001.cgm	5840	110	43			149	12	12	12	338
d002.cgm	7440	170	46			181	25	12	12	446
d003.cgm	10640	256	84			284	25	12	12	673
d004.cgm	27840	398	110	64	9	84	12			677
d005.cgm	5120	93	45	30		44		24	24	260
d006.cgm	5120	92	45	30		44		24	24	259
d007.cgm	5040	91	45	29		44		24	24	257
d008.cgm	5120	96	45	30		44		24	24	263
d009.cgm	5040	95	46	27		44		24	24	260
d010.cgm	5120	96	45	29		44		24	24	262
d011.cgm	5040	94	45	30		44		24	24	261
d012.cgm	5040	93	45	28		44		24	24	258
d013.cgm	5040	96	45	29		44		24	24	262
d014.cgm	4880	89	45	23		44		24	24	249
d015.cgm	3360	101	59	1		36				197
d016.cgm	3520	76	79	1		34				190
d017.cgm	5840	223	70	37		38				368
d018.cgm	6720	266	74	47		38	2	4		431
d019.cgm	2720	121	24			32				177
d020.cgm	1280	13	15	12		8				48
d021.cgm	3120	42	49	30		18		12		151
d022.cgm	1120	12	13	9		6				40
d023.cgm	1920	93	15	8		3				[illegible]
d024.cgm	2000	93	15	8		3				[illegible]
d025.cgm	1920	93	15	8		3				[illegible]
d026.cgm	2800	29	77	1		35				142
d027.cgm	4720	114	103	12		34	4			267
d028.cgm	1760	30	33	10		9				82
d029.cgm	3520	160	30	22		22				234
d030.cgm	3680	141	54	21		16				232
d031.cgm	3680	141	54	21		16				232
d032.cgm	3680	141	54	21		16				232
d033.cgm	3680	141	54	21		16				232

d034.cgm	3680	141	54	21		16				232
d035.cgm	5360	197	71	29		14		16		327
d036.cgm	4800	216	69	8		22		10		325
d037.cgm	5840	105	118	60		10				293
d038.cgm	1120	17	18	1		6				42
d039.cgm	25625	109	44	17	3	9		6		188
d040.cgm	3520	153	41	20		9		5		228
d041.cgm	1760	60	19	7		6				92
d042.cgm	2480	91	28	14		10				143
d043.cgm	7520	131	120	121		15	6	8		401
d044.cgm	2800	42	39	37		3		8		129
d045.cgm	3200	97	55	20		8		4		184
d046.cgm	3680	106	59	22		10	6	8		211
d047.cgm	4880	79	77	72		17				245
d048.cgm	2000	31	31	23		5				90
d049.cgm	4880	79	77	72		17				245
d050.cgm	2560	27	51	21		7		4		110
d051.cgm	1920	52	25	8		3		8		96
d052.cgm	1760	26	28	10		6		4		74
d053.cgm	1680	28	22	8		6		8		72
d054.cgm	1680	28	23	8		6		8		73
d055.cgm	1760	28	23	10		6		8		75
d056.cgm	2000	80	26	8				4		118
d057.cgm	6080	124	107	44		28		36		339
d058.cgm	5040	148	103	41		10	2			304
d059.cgm	119120	176	89	16	10	35		20		346
d060.cgm	5520	59	119	44		32	14	8		276
d061.cgm	5280	183	84	33		8	2	12		322
d062.cgm	2560	94	25	12		4		12		147
d063.cgm	1520	39	22			16				77
d064.cgm	5360	156	72	31		16		28		303
d065.cgm	2480	86	34	15		8				143
d066.cgm	2160	27	27	18				12	12	96
d067.cgm	3200	69	36	37		18				160
d068.cgm	2000	77	21	7		8				113
d069.cgm	2320	30	30	21		23			4	108
d070.cgm	2400	22	32	21		33				108
d071.cgm	2240	49	28	23		10	2			112
d072.cgm	2320	47	32	27		4				110
d073.cgm	2000	58	41			8		8		115
d074.cgm	2720	44	50	26		17				137
d075.cgm	1920	52	32			20				104
d076.cgm	5120	87	90	45		18		20		260
d077.cgm	6080	112	83	69		34		16		314
d078.cgm	4480	76	78	44		26	12			236
d079.cgm	1440	23	20	14		6				63
d080.cgm	146880	23	50	1	5	41	14			134
d081.cgm	2240	51	25	16		10	6			108
d082.cgm	1760	30	25			12		5	5	77

d083.cgm	1360	18	21			12	4	2		57
d084.cgm	8800	106	41	1	1	28	18	2		197
d085.cgm	1600	12	35			14				61
d086.cgm	2000	35	27	16		6		8		92
d087.cgm	1760	59	17	6		8				90
d088.cgm	1440	33	8	12		10				63
d089.cgm	960	3	10	6		8				27
d090.cgm	4720	127	59	37		45				268
d091.cgm	2480	18	60	17		14				109
Minimum	960	3	8	0	0	0	0	0	0	27
Maximum	146880	398	120	121	10	284	25	36	24	677

10.6 Table 3 - Errors in GTE Metafiles

All files have an error is the required string for CHARACTER SET LIST. Only those files with additional errors are listed here.

	Errors found with MetaCALS					
	ISO 8632				MIL-D28003	
File Number	Zero area CLIP RECTANGLE	END METAFILE missing	Refers to undefined foreground color	Invalid char in RESTRICTED TEXT	Invalid CHARACTER SET LIST	
d004	1				1	
d016		1			1	
d028			1		1	
d029		1			1	
d037			1		1	
d038			1		1	
d039			1		1	
d040			1		1	
d043			1		1	
d045				2	1	
d046			1	2	1	
d048			1		1	
d056		1			1	
d058		1			1	
d059				3	1	
d061			1	1	1	
d068		1			1	
d077		1			1	
d086			1		1	
d089		1			1	
d091			1		1	

Error message	Number of files in which found
CGM errors -	
A CLIP RECTANGLE is defined with zero area.	1
END METAFILE missing	7
Undefined foreground color referenced by a primitive.	11
RESTRICTED TEXT invalid, illegal characters	4
MIL-D-28003 errors -	
CHARACTER SET LIST invalid; must contain exactly the two list entries: (0,"4/2") and (1,"4/1").	91

10.7 List of Figures

Figure 1. Originating system's plot of metafile, d005.cgm, reduced to 90%, showing butt-joined and T-joined POLYLINEs.

Figure 2. MetaView plot of metafile, d005.cgm, reduced, showing apparent mismatch of butt-joined and T-joined POLYLINEs (shown to be due to a data error).

Figure 3. Originating system's plot of metafile, d004.cgm. This is the reference image for examining the effects of RESTRICTED TEXT and CELL ARRAY elements.

Figure 4. MetaView plot of metafile, d004.cgm, without "-r" option. Text, represented by the RESTRICTED TEXT element, is shifted to the left.

Figure 5. MetaView plot of metafile, d004.cgm, with "-r" option. Text, represented by the RESTRICTED TEXT element, is centered and is a satisfactory, though less than exact, match to the original text.

Figure 6. Demonstration of the image blocking of images by CELL ARRAYs. The partial plots on the left, with image blocking, are from the CGM with CELL ARRAYS; those on the right, without image blocking, are from the edited clear text CGM with CELL ARRAYs removed.

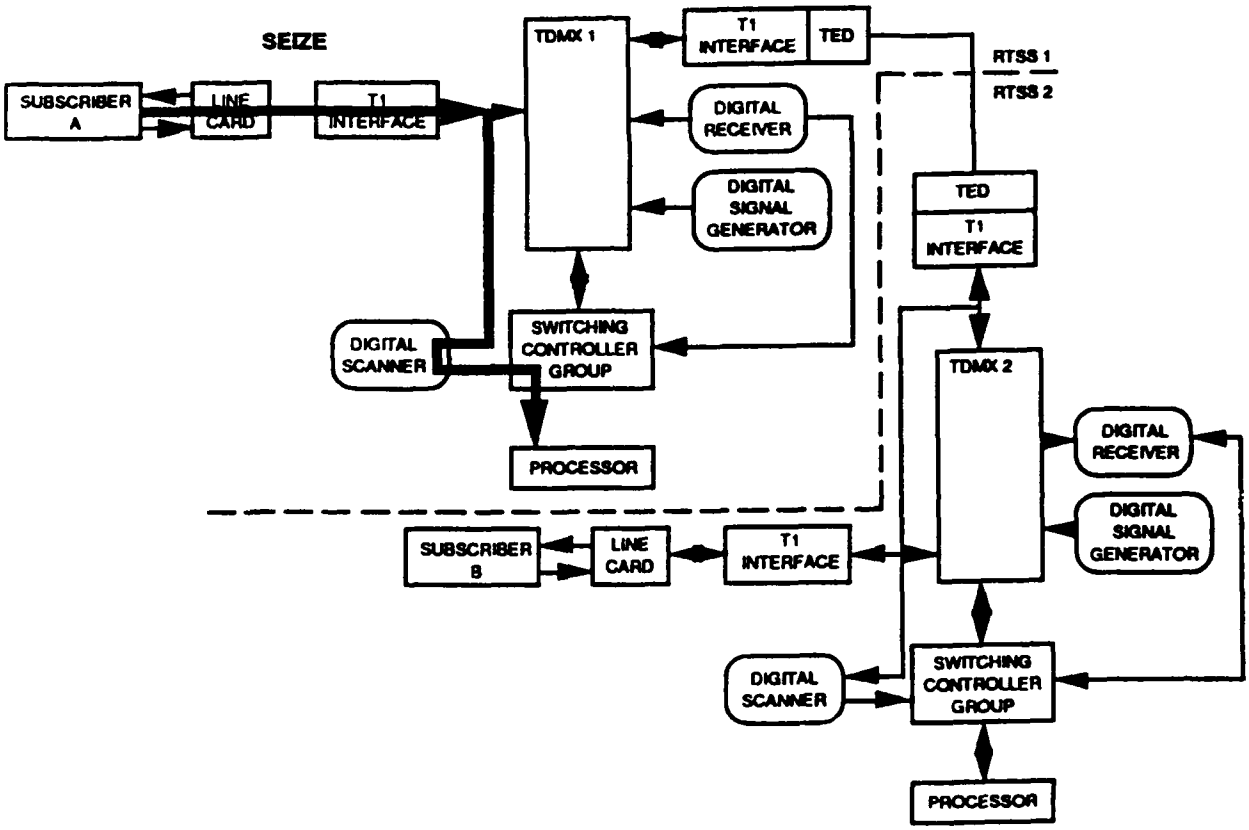


Figure 1. Originating system's plot of metafile, d005.cgm, reduced to 90%, showing butt-joined and T-joined POLYLINEs.

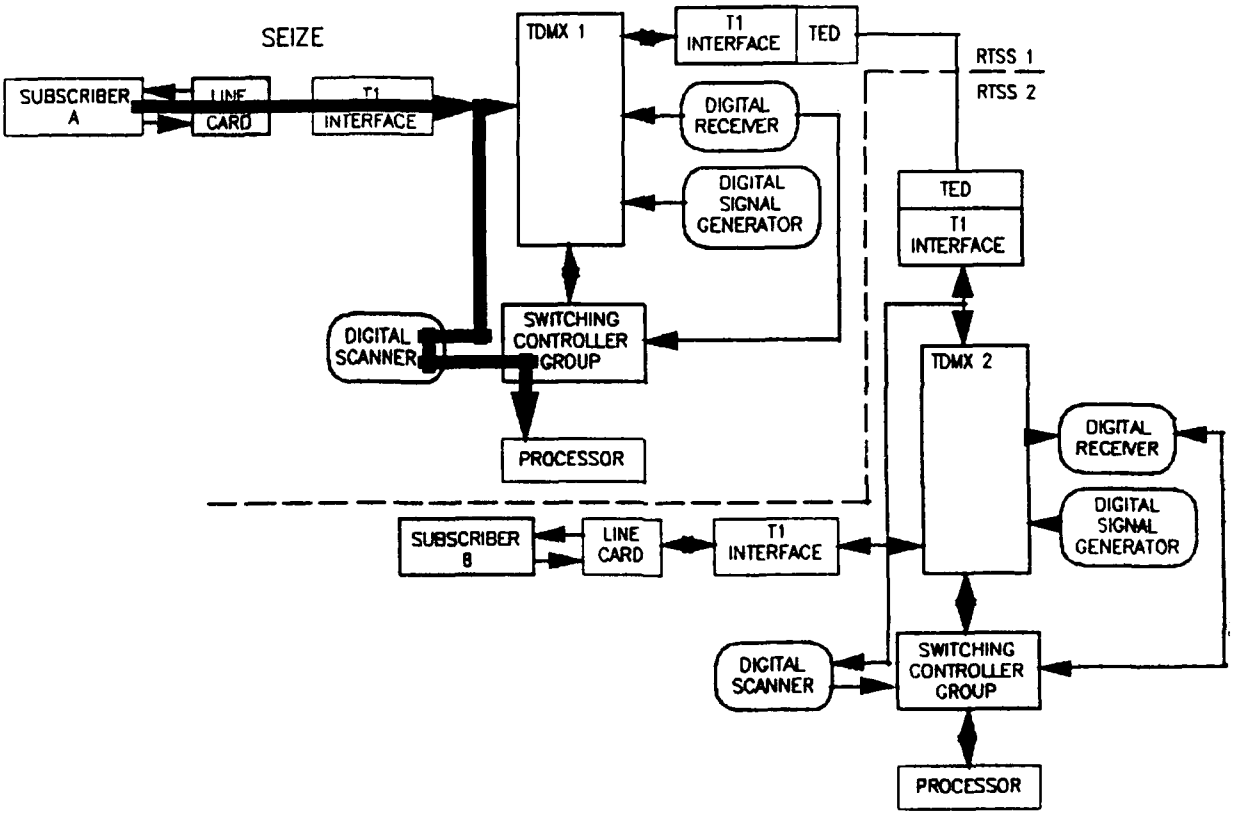


Figure 2. MetaView plot of metafile, d005.cgm, reduced, showing apparent mismatch of butt-joined and T-joined POLYLINEs (shown to be due to a data error).

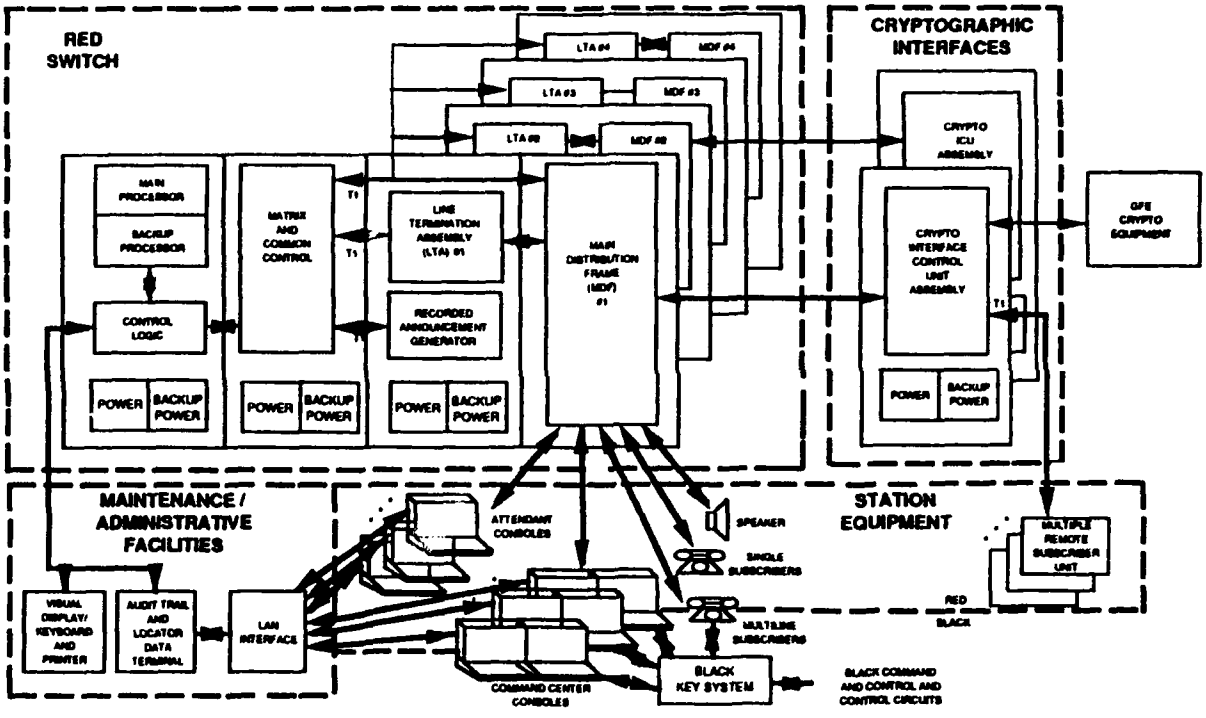


Figure 3. Originating system's plot of metafile, d004.cgm. This is the reference image for examining the effects of RESTRICTED TEXT and CELL ARRAY elements.

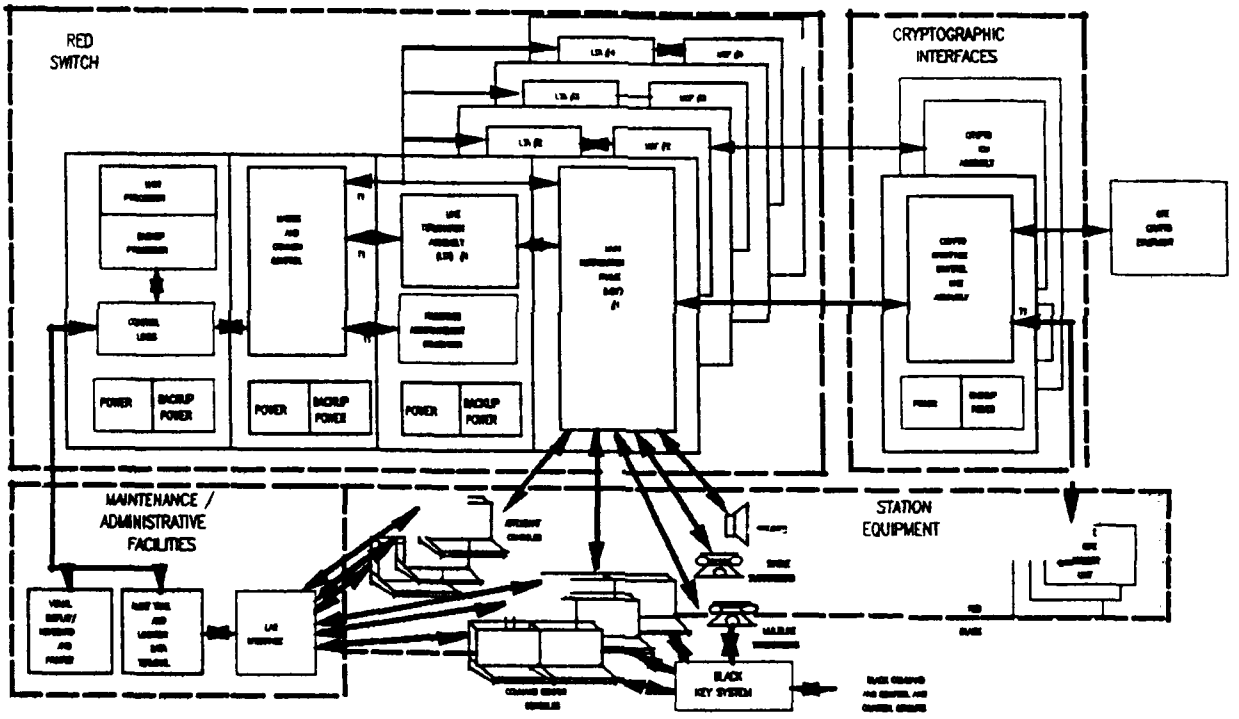


Figure 4. MetaView plot of metafile, d004.cgm, without "-r" option. Text, represented by the RESTRICTED TEXT element, is shifted to the left.

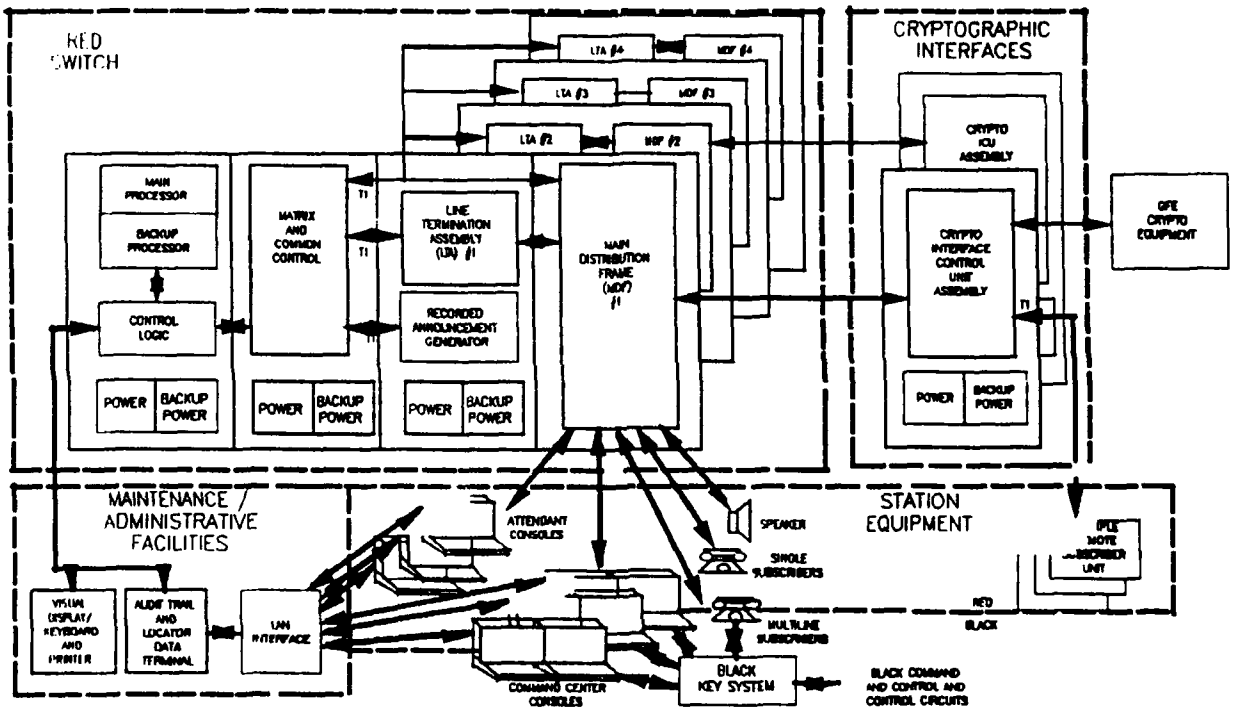
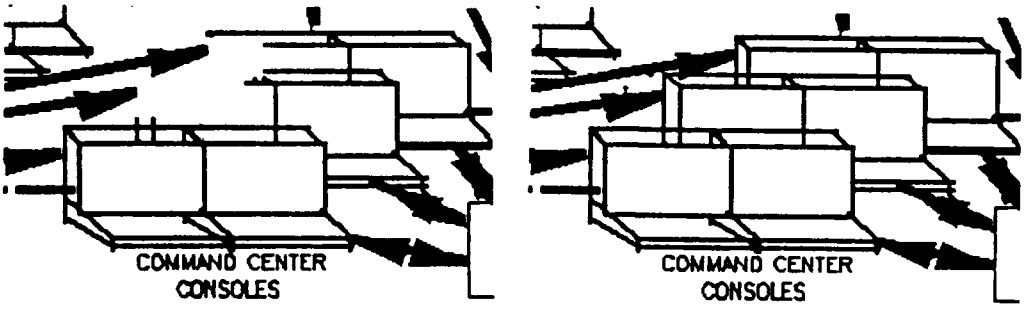
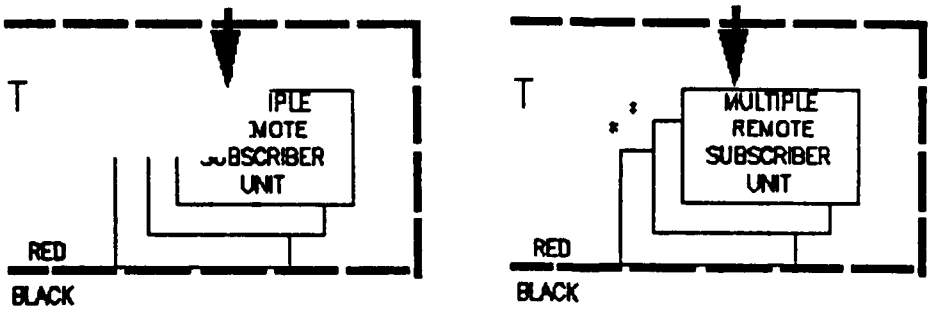


Figure 5. MetaView plot of metafile, d004.cgm, with "-r" option. Text, represented by the RESTRICTED TEXT element, is centered and is a satisfactory, though less than exact, match to the original text.



With CELL ARRAYs **Without** CELL ARRAYS.



With CELL ARRAYs **Without** CELL ARRAYS.

Figure 6. Demonstration of the image blocking of images by CELL ARRAYs. The partial plots on the left, with image blocking, are from the CGM with CELL ARRAYS; those on the right, without image blocking, are from the edited clear text CGM with CELL ARRAYs removed.